13. The method according to claim 11, wherein

the silicon source gas is dichlorosilane gas, and

the epitaxial film is formed at a temperature equal to or lower than 1100° C.

14. The method according to claim 11, wherein

the silicon source gas is trichlorosilane gas, and

the epitaxial film is formed at a temperature equal to or lower than 1150° C.

15. The method according to claim 11, wherein

the silicon source gas is silicon tetrachloride gas, and

the epitaxial film is formed at a temperature equal to or lower than 1200° C.

16. The method according to claim 11, wherein

the epitaxial film is formed at a temperature equal to or higher than 800° C. under a pressure in a range between atmospheric pressure and 100 Pa.

17. The method according to claim 11, wherein

the epitaxial film is formed at a temperature equal to or higher than 600° C. under a pressure in a range between 100 Pa and 1×10^{-5} Pa.

18. The method according to claim 6, wherein

the step of forming the trench includes the steps of:

forming an oxide film on the substrate as a mask for forming the trench; and

removing the oxide film after the trench is formed and before the step of forming the epitaxial film.

19. The method according to claim 6, wherein

the semiconductor substrate is a silicon substrate,

the bottom of the trench has a (110)-surface orientation of silicon crystal, and

the sidewall of the trench has a (111)-surface orientation of the silicon crystal.

20. The method according to claim 6, wherein

the semiconductor substrate is a silicon substrate,

the bottom of the trench has a (100)-surface orientation of silicon crystal, and

the sidewall of the trench has a (100)-surface orientation of the silicon crystal.

21. The method according to claim 6, wherein

the trench has an aspect ratio equal to or larger than two.

22. The method according to claim 6, wherein

the step of forming the epitaxial film further includes a first step,

the first step is such that the epitaxial film having an impurity doped in the epitaxial film is formed on the bottom and the sidewall of the trench to have a predetermined thickness,

the final step is such that the epitaxial film having no impurity doped or a low concentration impurity doped in the epitaxial film is formed to fill an inside of the trench, and

the low concentration impurity of the epitaxial film in the final step has an impurity concentration lower than that in the first step.

23. The method according to claim 22, further comprising the step of:

annealing the substrate after the step of forming the epitaxial film.

24. The method according to claim 23, wherein

the first and the final steps in the step of forming the epitaxial film and the step of annealing the substrate are successively performed in epitaxial film forming equipment.

25. The method according to claim 6, wherein

the step of forming the epitaxial film further includes a first step and a vapor phase diffusion step,

the first step is such that the epitaxial film having an impurity doped in the epitaxial film is formed on the bottom and the sidewall of the trench to have a predetermined thickness,

the vapor phase diffusion step is such that an impurity is doped from a surface of the epitaxial film by a vapor phase diffusion method to form an impurity doped region in the epitaxial film,

the final step is such that the epitaxial film having no impurity doped or a low concentration impurity doped in the epitaxial film is formed to fill an inside of the trench, and

the low concentration impurity of the epitaxial film in the final step has an impurity concentration lower than that in the first step.

26. The method according to claim 25, wherein

the vapor phase diffusion method is performed in such a manner that a dopant gas is supplied to the substrate, which is heated up to a predetermined temperature.

27. The method according to claim 25, further comprising the step of:

annealing the substrate after the step of forming the epitaxial film.

28. The method according to claim 27, wherein

the first, the vapor phase diffusion and the final steps in the step of forming the epitaxial film and the step of annealing the substrate are successively performed in epitaxial film forming equipment.

29. The method according to claim 6, wherein

the step of forming the epitaxial film further includes a vapor phase diffusion step,

the vapor phase diffusion step is such that an impurity is doped from the bottom and the sidewall of the trench by a vapor phase diffusion method to form an impurity doped region in the bottom and the sidewall of the trench,

the final step is such that the epitaxial film having no impurity doped or a low concentration impurity doped in the epitaxial film is formed to fill an inside of the trench, and